

# NASA SCIENCE MISSION DIRECTORATE

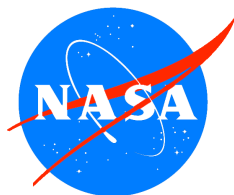
---

*Earth Science Division  
Applied Sciences Program  
Air Quality Program Element  
FY2007-2011 Plan*



FINAL DRAFT

Date: 11/10/2006



*Expanding and accelerating the realization of economic and societal  
benefits from Earth system science, information, and technology*

## **NASA Earth Science Division - Applied Sciences Program**

### *Air Quality Program Element*

---

#### **TABLE OF CONTENTS**

---

<b>I. PURPOSE AND SCOPE</b>	<b>1</b>
<b>II. OBJECTIVES</b>	<b>2</b>
<b>III. AIR QUALITY ISSUES, RELATED RESEARCH AND DECISION SUPPORT TOOLS</b>	<b>4</b>
<b>IV. PROJECTS AND ACTIVITIES</b>	<b>6</b>
<b>A. SOLICITED PROJECTS</b>	
<b>B. DIRECTED PROJECTS</b>	
<b>C. CONGRESSIONALLY DIRECTED PROJECTS</b>	
<b>V. PROGRAM MANAGEMENT &amp; CROSSCUTTING SOLUTIONS SUPPORT</b>	<b>26</b>
<b>A. PROGRAM MANAGEMENT ACTIVITIES</b>	
<b>B. CROSSCUTTING SOLUTIONS SUPPORT</b>	
<b>VI. BUDGET: FY2007-2011</b>	<b>31</b>
<b>VII. SCHEDULE AND MILESTONES</b>	<b>32</b>
<b>VIII. PROGRAM MEASURES</b>	<b>36</b>
<b>APPENDICES</b>	<b>37</b>
<b>A. POINTS OF CONTACT</b>	
<b>B. ROADMAP</b>	
<b>C. ACRONYMS</b>	

The Applied Sciences Program websites contain additional information about the program and this program element:

Applied Sciences Program:	<a href="http://science.hq.nasa.gov/earth-sun/applications">http://science.hq.nasa.gov/earth-sun/applications</a>
Air Quality Element:	<a href="http://science.hq.nasa.gov/earth-sun/applications/theme2.htm">http://science.hq.nasa.gov/earth-sun/applications/theme2.htm</a>
Project Tracking & Reporting	<a href="http://aiwg.gsfc.nasa.gov">http://aiwg.gsfc.nasa.gov</a>

## **NASA Science Mission Directorate – Applied Sciences Program**

### *Air Quality Program Element Plan: FY 2007 - 2011*

#### **I. Purpose and Scope**

The NASA Applied Sciences Program collaborates with partner organizations to enhance the application of NASA Earth science research results to serve issues of national priority. The desired outcome is for partner organizations to use project results, such as prototypes and benchmark reports, to enable the sustained, operational use of Earth science products and enhance their decision support capabilities.

The NASA Applied Sciences Program collaborates with partner organizations to enhance the application of NASA Earth science research results to serve issues of national priority. The desired outcome is for partner organizations to use project results, such as prototypes and benchmark reports, to enable the sustained, operational use of Earth science products and enhance their decision support capabilities.

The Air Quality Management Program Element is one of twelve National Applications elements in the Applied Sciences Program. The goal of the Air Quality Management Program Element is to: Enable partners' beneficial use of NASA Earth science research results to enhance decision support capabilities serving their air quality management and policy responsibilities and to expand the sustained use of NASA Earth science products within the air quality community.

This plan articulates the direction, objectives, and projects for the Air Quality Management Program Element (a.k.a., program) for FY2007-2011. The Air Quality program extends NASA Earth science research results and addresses issues of concern and decision-making related to air quality planning, forecasting, compliance, and emissions inventories (a crosscutting item). The program focuses on enhancing air quality policy and management decision support tools serving the following classes of issues:

- Assessment and emission control strategies
- Sources, transport and deposition
- Regulation and Compliance
- International policies and treaties
- Economic management and trade
- Public and environmental health

By 2011, the primary goal of the Air Quality Program Element is to benchmark the potential improvement of NASA Earth Science research results from at least 7 different sensors and Earth science models to at least 4 different decision support systems related to air quality planning, compliance, and forecasting.

While air quality issues range from local to regional to intercontinental issues, the program works at regional/national scales and larger if the decision support tools serve issues of national importance and value.

From FY02-06, the program focused largely on atmospheric chemistry and aerosols. In FY06-7, the program initiated activities related to physical meteorology as potential Earth science products to extend to air quality forecasting and planning. In FY07-11, the program will seek to establish a portfolio that includes chemistry, aerosols, physical, and land-cover aspects. While the program aligns most with the Atmospheric Composition science focus area, the program seeks to extend NASA Earth science research results from any and all of the

science focus areas.

NASA partners with Federal agencies and regional-national organizations that have air quality management responsibilities and mandates to support air quality managers. Currently, the primary partners are the US Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA). The program includes participation from international organizations on air quality activities usually through a US partner. Some program activities may relate to the Public Health, Energy Management, and other program elements. Through its activities, the Air Quality program provides results for NASA support to Administration, interagency, and international activities, including the White House Committee on Environment and Natural Resources (CENR), international and US Group on Earth Observations (GEO, USGEO), Climate Change Science Program (CCSP), and the Integrated Global Atmospheric Chemistry Observations (IGACO).

The program serves the 2006 NASA Strategic Plan Goal 3, and the 2007 NASA Integrated Budget and Performance Document (IBPD) Mutiyear Outcome 3A.7 Annual Performance Goals 7ESS11 and 7ESS12.

Examples of Earth science missions (existing and in development) for the program include: Aura, CloudSat, CALIPSO, Glory, NPP, and Aqua. Examples of Earth science models include: RAQMS, GOCART, MM5, Hysplit, GMAO, WRF-CHEM, and GEOS-CHEM. Project plans associated with the Air Quality Management program articulate the specific project activities to apply Earth science measurements, including specific sensors and models.

## **II. Objectives: FY2007-2011**

In FY07, the program's priority activities focus on:

- expanding and verifying use of Aura and CALIPSO products in air quality forecasting
- benchmarking use of LIS NH3 in CMAQ and use of MODIS in WRAP Regional Haze SIPs
- initiating activities in the compliance theme of the program
- initiating activities on international aspects of air quality
- evaluating potential of Glory in air quality decision support tools
- examine use of land-cover characteristics in major air quality models and decision support systems
- initiating use of Rapid Prototypes for proof-of-concept studies
- examine opportunities or NASA Earth science results to enhance emissions inventories

In FY08-11, the program's priorities focus on

- benchmarking projects selected under REASoN, Decisions04, and ROSES05
- expanding focus on air quality model products to serve decision support tools
- verifying use of physical atmospheric data in air quality models/DSTs
- expanding outreach activities, data delivery/use mechanisms, and international aspects (e.g., GEO)
- initiating activities on the land-cover characteristics in air quality decision support tools/models
- soliciting projects to begin in FY08-FY11
- identifying emerging priority AQ issues that NASA Earth science research results can support
- evaluating and extending products from future sensors (e.g. OCO, NPP)

Priority air quality constituents continue to be ozone, aerosols (PM2.5), other EPA criteria pollutants, and emissions indicators (e.g., NO2, HCHO).

## QI - II 2007

- Benchmark use of LIS NH3 products in CMAQ
- Initiate ROSES05 projects and complete project plans.
- Evaluate application of Glory products to serve AIRNow, CMAQ, and/or other priority air quality decision support tools;
- Evaluation/project plan on NASA Earth science results for EPA NOx compliance
- Develop materials with NASA/interagency partners to support national and international awareness and use of NASA Earth science products

---

## QIII - IV 2007

- Benchmark use of MODIS products in WRAP RPO SIP process
- Complete evaluation report of NASA science capabilities related to specifications of land-cover characteristics for use in CMAQ and other priority air quality decision support tools.
- Evaluate potential of CALIPSO and CloudSat to serve CMAQ, GFS, other tools
- Report use of NASA products in SIP development via TexAQS/Aura validation and EOS Follow-on Project
- Support at least one training session on NASA Earth science air quality products
- Support and/or coordinate NASA activities in interagency HTAP effort

---

## 2008

- Complete benchmark of REASoN project on community access and use of NASA aerosol products
- Evaluate application of OCO products to serve AIRNow, CMAQ, and/or other priority air quality decision support tools; evaluate transition of MODIS to NPP/VIIRS for air quality forecasting and existing applications

---

## 2009

- Benchmark use of CALIPSO in 3-D AQS (Decisions04)
- Benchmark use of MODIS in BlueSkyRAINS (Decisions04)
- Evaluate application of NPP products to serve AIRNow, CMAQ, and/or other priority air quality decision support tools;
- Publish at least three articles (FY07-09) on air quality applications of NASA Earth science products, including at least one in a peer-reviewed journal

---

## 2010

- Benchmark use of Aura in AQ forecasting (ROSES05)
- Benchmark use of MISR, QuikSCAT, MOPPIT and Aura OMI in AirQuest (ROSES05)
- Benchmark use of NASA physical atmospheric data (GOES, MODIS) in CMAQ (ROSES05-Dec.

Augmentation)

- Evaluate potential of Decadal Survey missions to Air Quality decision support tools

---

2011

- Verify, validate, and complete benchmark reports on performance of NASA science products from at least 7 sensors and models into at least 4 separate air quality issues or decision support tools.
- Publish at least six articles (FY07-11) on air quality applications of NASA Earth science products, including at least three in peer-reviewed journals
- Benchmark reports on ROSES07 projects

### **III. Air Quality Issues, Related Research, and Decision Support Tools**

The program routinely consults with partners to identify important issues facing the air quality community, examines associated decision support tools, and determines priorities within the Air Quality Management program portfolio. Topics include:

- Long-range air pollution transport
- International atmospheric treaties
- Land-characteristics in air quality models
- Aviation-related pollution (airborne and ground)
- Visibility and regional haze
- Emerging air pollution issues: Mercury, POPs
- Air quality regulation accountability

The program assesses direction and priorities identified by partner agency representatives and strategic plans and from interagency working groups (e.g., CENR AQRS, USGEO, CCSP) assessment reports and workplans.

#### **Air Quality Management-related Research**

The Air Quality Management website contains a list of air quality-related research projects that the NASA Earth Science Division has supported. These projects provide insight into emerging research directions, knowledge, capabilities, and products.

In addition, the Applied Sciences Research Knowledge Base provides a venue to search for specific terms and results.

#### **Priority Decision Support Tools**

The following describe priority Decision Support Tools the program focuses on in the near-term.

#### **AIRNow and Air Quality Index**

EPA provides a data clearinghouse, central forecast facility, and archive for regionally and locally generated daily air quality forecasts under its AIRNow Program, which developed the AQI as a health-based index for reporting air quality. AIRNow gathers data from numerous sources, including a nation-wide network of in situ monitors and has an AQI for PM, ozone, and other air pollutants (carbon monoxide, sulfur dioxide, and nitrogen dioxide). EPA, state and local agencies, and the media report current and forecast AQI and air quality conditions. ([www.epa.gov/airnow](http://www.epa.gov/airnow)).

### Community Multi-scale Air Quality Model

EPA, with assistance from NOAA and the modeling community, developed the Community Multi-scale Air Quality model (CMAQ/Models-3), to improve the environmental management community's ability to evaluate the impact of management practices for multiple pollutants and multiple scales and to improve the scientist's ability to understand and simulate chemical and physical interactions in the atmosphere. CMAQ is a comprehensive air quality modeling system, and CMAQ simulates processes to describe the generation, fate, and transport of atmospheric pollutants and urban, regional, and national air quality over several time scales. EPA, States and Regional Planning Offices (RPO) use CMAQ to simulate effects of pollution control options, assess multi-pollutant impacts, track and predict changes in emissions mitigation strategies, develop implementation plans, and make regulatory decisions. CMAQ is also the basis for work on air quality forecasting activities, such as WRF-CHEM. [www.epa.gov/asmdnerl/models3](http://www.epa.gov/asmdnerl/models3)

### NOAA Forecasting

NOAA, in cooperation with EPA, began providing operational, daily air quality forecasting in September 2004. Initial guidance focuses on 1-2 day ozone forecasts for the Northeastern U.S. NOAA plans to expand the coverage incrementally to cover the entire nation by 2008. In addition, NOAA plans to include PM forecasts within five years; NOAA plans to add additional pollutants within the decade and extend forecast intervals to two days or beyond. The initial operational modeling system, to be run at NOAA's NCEP, will consist of NOAA's Eta meteorological model linked with EPA's CMAQ model. The coupled Eta-CMAQ system will initially produce forecasts with a grid resolution of 12 km. Major issues related to air quality forecasting include emissions sources, transport/dispersion, and weather. Key NOAA activities to improve ozone forecasting include reducing land-use error, temperature interpolation error, and boundary conditions. [http://www.nws.noaa.gov/ost/air\\_quality/](http://www.nws.noaa.gov/ost/air_quality/)

### Emissions Inventories

Emissions inventories cut across several aspects of the Air Quality program. EPA prepares a national database of air emissions information (a.k.a., emissions inventory) with input from numerous State and local air quality monitoring/reporting agencies. These data are used for air dispersion modeling, regional strategy development, regulation setting, air toxics risk assessment, and tracking trends in emissions over time. The EPA emissions inventory contains CO, NO<sub>x</sub>, SO<sub>2</sub>, PM, VOCs, and NH<sub>3</sub>. The inventory defines the pollutant sources as point, area, or mobile. The NASA Air Quality program works with partners on appropriate priorities and activities related to emissions inventories, such as emissions from wildfires or measurable natural and anthropogenic (HCHO, NO<sub>2</sub>) sources or proxies. [www.epa.gov/ttn/chief/net/index.html](http://www.epa.gov/ttn/chief/net/index.html)

### Weather Research and Forecasting - Chemistry (WRF-Chem)

WRF is a next-generation meteorological model being developed collaboratively among several agencies (NOAA/NCEP, NOAA/FSL, NCAR). WRF-Chem is a version of WRF that simulates trace gases and aerosols simultaneously with meteorological fields in the WRF framework. WRF-Chem model will have the option to simulate the coupling between dynamics, radiation and chemistry. Uses include forecasting chemical-weather, testing air pollution abatement strategies, planning and forecasting for field campaigns, analyzing measurements from field campaigns and the assimilation of satellite and in-situ chemical measurements. [www.wrf-model.org](http://www.wrf-model.org)

### Global Forecasting System (GFS)

The Global Forecast System (GFS) is global numerical weather prediction model run by NOAA. GFS is a global spectral model with physical parameterizations. This model is run four times a day and produces forecasts up 16 days in advance, but with decreasing spatial and temporal resolution over time. (Wikipedia)

#### Long Range Transboundary Air Pollution/Hemispheric Transport of Air Pollution (LRTAP/HTAP)

The Convention on Long-range Transboundary Air Pollution (LRTAP) currently has eight protocols. The UN Economic Commission for Europe (UNECE) provides the Secretariat for the Convention. In December 2004, the UNECE established a new task force on Hemispheric Transport of Air Pollutants (HTAP) to address the intercontinental transport in the Northern Hemisphere. From 2005-2009, this technical task force will assess the scientific evidence concerning hemispheric transport for use in international policy discussions and reviews of LRTAP protocols.

#### **IV. Project and Activities**

The Air Quality Management Program Element conducts projects to support the program's goal and objectives. The projects fall into three types: Solicited Projects, Directed Projects, and Congressionally-Directed Activities. The respective Project Managers and teams are responsible for developing project plans, managing the activities, and reporting issues and results. Generally, the projects involve the following activities:

- Develop and nurture partnerships with appropriate air quality organizations;
- Identify and assess partners' air quality management responsibilities, plans, and decision support tools and evaluate capacity of Earth science results to support the partners;
- Validate & verify application of Earth science results with partners, including development of prototypes;
- Cooperate with partners to document the performance and value of Earth science results relative to partners' benchmarks and to support adoption into operational use; and,
- Communicate results & partners' achievements to appropriate air quality communities and stakeholders.

Plans, status, and results for each project are available through: <http://aiwg.gsfc.nasa.gov>



<b>Project: ROSES 05</b>					<b>Solicitation</b>																			
<p><b>The purpose of this project is to assess the potential for Assimilating Aura-derived Trace Gas Retrievals to improve the performance of DOE, NPS, RPOs, and over 200 broadcast meteorologists's Operational Multipollutant Ensemble Air Quality Forecast DSS used in Ozone and Haze Prediction for mitigating episodic and regional air quality episodes.</b></p>					<i>Budget (\$K)</i>																			
<p>This project incorporates assimilated tropospheric-NO2 from AURA/OMI and upgraded MODIS aerosol optical depth (AOD) to improve operational ozone and haze forecasts. End-users include DOE, NPS, RPOs, and over 200 broadcast meteorologists that use air quality forecasts from the AQF-DSS. If successful, the improved AQF-DSS (CMAQ and MAQSIP-RT – MM5/WRF, SMOKE) will provide users with increased confidence in mitigating episodic and regional air quality episodes year-round and nationally; benefits may also include reductions in harmful exposures while encouraging more effective strategies for long-term sustainable reductions in mean levels of criteria pollutants. Washington University, VISTAS RPO, the Center for Air Pollution Impact and Trend Analysis (CAPITA), and the Lantern Corporation are collaborators on this project.</p>																								
<i>Project Monitor/ Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	311																			
Doreen Neil LaRC	GSFC	FY07 - FY09	Wash.Univ., VISTAS, Lantern	FY09	0																			
				FY10	0																			
				FY11	0																			
<i>Principal Investigator(s)</i>		<i>John McHenry, Barons Met. Svcs.</i>		<i>Other Apps.</i>																				
<i>Earth Science Products</i>		mission: <i>Aura, Terra</i> sensor: <i>MODIS, OMI</i> products: <i>AOD, LIS</i> models: <i>Deep Blue Algorithm</i>																						
<i>Deliverables</i>		<table border="1"> <thead> <tr> <th><u>Description</u></th> <th><u>End Date</u></th> <th><u>IBPD Metric #</u></th> </tr> </thead> <tbody> <tr> <td>Project Plan</td> <td>1/1/2008</td> <td></td> </tr> <tr> <td>Evaluation Report</td> <td>1/1/2008</td> <td></td> </tr> <tr> <td>V&amp;V / Prototype Demonstration</td> <td>10/1/2009</td> <td></td> </tr> <tr> <td>V&amp;V / Operational Demo</td> <td>1/1/2009</td> <td></td> </tr> <tr> <td>Benchmark Report</td> <td>8/1/2009</td> <td></td> </tr> </tbody> </table>					<u>Description</u>	<u>End Date</u>	<u>IBPD Metric #</u>	Project Plan	1/1/2008		Evaluation Report	1/1/2008		V&V / Prototype Demonstration	10/1/2009		V&V / Operational Demo	1/1/2009		Benchmark Report	8/1/2009	
<u>Description</u>	<u>End Date</u>	<u>IBPD Metric #</u>																						
Project Plan	1/1/2008																							
Evaluation Report	1/1/2008																							
V&V / Prototype Demonstration	10/1/2009																							
V&V / Operational Demo	1/1/2009																							
Benchmark Report	8/1/2009																							
Budget is proposed (pre-negotiation)																								
<i>Notes:</i>																								

<b>Project:</b> ROSES05					Solicitation	
<p><b>The purpose of this project is to assess the potential for observations from GOES, QuikSCAT, Terra MISR and MOPITT, Aura OMI, and Terra or Aqua MODIS to improve the performance of NW-AIRQUEST's AQ-DSS used in meteorological, air quality, and smoke forecasts for improving the efficiency and effectiveness of air quality management within the Pacific Northwest.</b></p> <p>The Northwest International Air Quality Environmental Science &amp; Technology (NW-AIRQUEST) consortium uses the MM5 weather system, the AIRPACT-3, ClearSky, and BlueSky forecast systems to form a comprehensive air quality decision support system (AQ-DSS) that would improve the accuracy of meteorological, air quality, and smoke forecasts. This project incorporates GOES water-vapor and cloud track, QuikSCAT SeaWinds Scatterometer winds, Terra MISR Leaf Area Index and Fractional PAR for phenology of vegetation, Terra MOPITT and Aura OMI tropospheric retrievals for ozone and carbon monoxide, Forest-Service-STI BlueSky RAINS project MODIS-derived fire emissions, and Terra (or Aqua) MODIS column aerosol mass into the weather and forecast systems. NW-AIRQUEST partners can use the improved air quality forecasts to improve the efficiency and effectiveness of air quality management within the Pacific Northwest. Washington State University, the University of Washington, and the National Center for Atmospheric Research (NCAR) are collaborators on this project.</p>					Budget (\$K)	
					FY07	335
<i>Project Monitor/ Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	323	
D. Neil	n/a	FY07 - FY09	Univ. Wash, NCAR	FY09	0	
				FY10	0	
				FY11	0	
<i>Principal Investigator(s)</i>		Brian Lamb, Wash. St. Univ.		<i>Other Apps.</i>		
<i>Earth Science Products</i>	mission: GOES, QuikSCAT, Terra, Aqua, Aura					
	sensor: MISR, MOPITT, OMI, MODIS					
		products:				
		models:				
<i>Deliverables</i>	<u>Description</u>	<u>End Date</u>	<u>IBPD Metric #</u>			
	Project plan	1/1/2008				
	Evaluation Report	1/1/2008				
	V&V / Prototype Demonstration	10/1/2009				
	V&V / Operational Demo.	1/1/2009				
	Benchmark report	8/1/2009				
<i>Notes:</i>						

Project: EOS Follow-on: EOS Products for Air Quality Management					Solicitation	
<p>The purpose of this project is to assess the potential for GOES albedo and insolation data as well as MODIS albedo and land-surface emissivity to improve the performance of EPA’s MM5-CMAQ Modeling System used in improving the physical atmosphere in which emission reduction scenarios are evaluated for more robust SIP testing .</p> <p>The National Space Science and Technology Center (NSSTC) utilizes the EPA-developed Mesoscale Meteorological Model and the Community Multiscale Air Quality Modeling System (MM5-CMAQ) to improve the State Implementation Plan (SIP) modeling process. SIP defines emission reduction strategies to bring air-pollution levels into compliance with National Ambient Air Quality Standards (NAAQS). This project incorporates GOES albedo and insolation data as well as MODIS albedo and land-surface emissivity into the MM5-CMAQ Modeling System to improve the physical atmosphere in which emission reduction scenarios are evaluated. The EPA, state and local governments, and the private air-quality consulting community can use the more robust SIP testing to give regulatory agencies and industries model results that can be trusted, avoiding SIP delays and litigation</p>				Budget (\$K)		
				FY07	335	
Project Monitor/ Center	Other NASA Centers	Timeframe	Partners	FY08	0	
Project Monitor D.Neil	n/a	FY06 - FY09	NOAA, EPA	FY09	0	
				FY10	0	
				FY11	0	
Principal Investigator(s)				Other Apps.		
Earth Science Products	mission: sensor: products: models:					
Deliverables	Description	End Date	IBPD Metric #			
	Project Plan					
	Evaluation Report					
	V&V / Prototype Demonstration	5/1/2008				
	V&V / Operational Demo.	6/1/2008				
	Benchmark report	6/1/2009				
<p>Budget is proposed (pre-negotiation). He received funds from Decisions-Augmentation (FY05 funds in FY06 – project will likely continue into FY09.</p> <p>Notes:</p>						

Project: Decisions 04 Three-Dimension Air Quality System (3D-AQS)					Solicitation	
The purpose of this project is to assess the potential for AIRS, MODIS, OMI, GOES, and CALIPSO observations to improve the performance of US EPA’s AQS used in public health tracking and air quality mapping for meeting air quality standards.					Budget (\$K)	
					FY07	421
The project seeks to incorporate a range of remote sensing data (AIRS, MODIS, OMI, GOES, CALIPSO, and others) to expand the US EPA Air Quality System (AQS) into a three-dimensional system supporting the Centers for Disease Control’s (CDC) environmental public health tracking network and NOAA’s air quality mapping system. Municipalities and states use information from AQS and AIRNow forecasting system to assess airborne particulate levels and implement measures to meet the ambient air quality standards.						
Project Monitor/ Center	Other NASA Centers	Timeframe	Partners	FY08	0	
Project Monitor D. Neil	n/a	FY06 - FY09	CDC, EPA, NOAA, Battelle, UW-Mad.	FY09	0	
				FY10	0	
				FY11	0	
Principal Investigator(s)		Ray Hoff, UMBC		Other Apps.		
Earth Science Products	mission: GOES, CALIPSO, sensor: AIRS, MODIS, OMI products: REALM, MPLNET, AERONET models:					Pub. Health
Deliverables	<u>Description</u>		<u>End Date</u>	<u>IBPD Metric #</u>		
	Project Plan		9/1/2006			
	Evaluation Report					
	V&V / Prototype Demonstration		8/1/2008			
	V&V / Operational Demo.		2/1/2009			
	Benchmark report		6/1/2009			
Funding provided circa May 2006 – project to run approx. June 2006 – June 2009.						
Notes:						

Project: Decisions04					Solicited	
The purpose of this project is to assess the potential for the integration of NASA MODIS products to improve the performance of the USFS and EPA’s BlueSkyRAINS tool used in predicting emissions and air quality impacts from fires for decisions about prescribed burns policy decisions about emissions transport, regional haze, and state implementation plans.  The project automates the integration of NASA MODIS products and other Earth science products to improve the timeliness and accuracy of BlueSkyRAINS, enhance predictions of emissions and air quality impacts from fires, and expand its use nationwide. Smoke and fire managers use the BlueSkyRAINS tool to make daily decisions about prescribed burns, and air quality agencies use the tool to support policy decisions and public notification about emissions transport, regional haze, and state implementation plans. The US Forest Service, Western Regional Air Partnership, Central Regional Air Planning Association, US Environmental Protection Agency (EPA), NOAA, and others are collaborators on this project.				Budget (\$K)		
				FY07	312	
Project Monitor/ Center	Other NASA Centers	Timeframe	Partners	FY08	0	
Project Monitor D.Neil	n/a	FY06 - FY09	USFS, RPOs, EPA, NOAA	FY09	0	
				FY10	0	
				FY11	0	
Principal Investigator(s)		Dana Sullivan, Sonoma Tech.		Other Apps.		
Earth Science Products	mission: Terra, Aqua sensor: MODIS products: models:		Disaster Man.			
	Deliverables	Description				End Date
Project Plan		9/1/2006				
V&V / Prototype Demonstration		8/1/2008				
V&V / Operational Demo.		2/1/2009				
Benchmark report		6/1/2009				
Funding provided circa May 2006 – project to run approx. June 2006 – June 2009.						
Notes:						

Project: REASoN					Solicited	
<p>The purpose of this project is to assess the potential for Terra and Aqua MODIS aerosol products and Federated PM network to improve the performance of EPA and RPO’s forecasting and emissions inventories used in public health warnings, transport waivers, and emission control strategies for public and environmental health and economics.</p>				Budget (\$K)		
				FY07	334	
<p>This activity partners with EPA, RPOs, and state organizations to develop a Federated PM network and associated tools to produce NASA science aerosol products to the Air Quality community, especially Web-tools to support decision making through data access, visualization, and analysis.</p>						
Project Monitor/ Center	Other NASA Centers	Timeframe	Partners	FY08	0	
Project Monitor D.Neil	n/a	FY04 - FY08	EPA, RPOs, States	FY09	0	
				FY10	0	
				FY11	0	
Principal Investigator(s)		Stefan Falke – Wash. Univ. in St. Louis		Other Apps.		
Earth Science Products	mission: Terra, Aqua					
	sensor: MODIS					
Deliverables	products:					
	models:					
	<div><div>Description</div><div>End Date</div><div>IBPD Metric #</div><div>Project plan</div><div>Semi-annual reports</div><div>Results conference</div></div>					
Notes: NASA funding was late to this project so activities (and costing) will continue into FY08 (and perhaps FY09).						

Project: EPA STAR - Emissions Inventory					Solicited	
<p>The purpose of this project is to assess the potential for MISR-derived smoke plume heights to improve the performance of the EPA’s Climate/Fire/Air Quality Assessment used in assessing the effects of fires in a future climate on air quality for examining how different scenarios of future fires will affect air quality in a future climate.</p> <p>The project seeks to use MISR-derived smoke plume heights to support assessment of the effects of fires in a future climate on ozone and particulate matter (PM) air quality in the United States, allowing also for changes in anthropogenic and biogenic emissions. This assessment will quantify the effects of present day fires on air quality in the United States to support assessment of effects of future fires (magnitude and frequency), relate plume height to area burned for use in climate change scenarios, and examine how different scenarios for future fires will affect air quality in a future climate (including uncertainties). Applied Sciences support is for labor for JPL to support MISR products (EPA cannot pay other Federal agency personnel). Other Earth science products leveraged in this project include: area burned prediction schemes with NASA/GISS GCM for 2000-2050; global aerosol-chemistry model, GEOS-CHEM; CMAQ, which will use initial and dynamic boundary conditions from the GISS and GEOS-CHEM simulations.</p>				Budget (\$K)		
				FY07	50	
Project Monitor/ Center	Other NASA Centers	Timeframe	Partners	FY08	0	
AQ Team D. Tralli	JPL	FY07 - FY07	EPA, Harvard Univ.	FY09	0	
				FY10	0	
				FY11	0	
Principal Investigator(s)		Jennifer Logan-Daniel Jacob/Harvard		Other Apps.		
Earth Science Products	mission: Terra					
	sensor: MISR					
	products:					
	models: NASA/GISS GCM, GEOS-CHEM, and CMAQ					
Deliverables	Description		End Date	IBPD Metric #		
	Benchmark report		6/1/2008			
Notes: Funding from EPA has been delayed until late in FY06. The NASA Funds (FY05-FY07) are used to help create a database of MISR smoke plumes. This database will be used during the project, which is likely to last in FY08 even though NASA funds only go to FY07.						

<b>Project:</b> EPA AMI					Solicited	
<p><b>The purpose of this project is to assess the potential for Aura OMI, MODIS AOD, CALIPSO, RAQMS together with EPA ozone and PM ground-networks, CMAQ-Eta to improve the performance of EPA's AQS, CAIR, OOS, CMAQ used in AQ policy development and compliance assessment for AQ accountability.</b></p> <p>NASA supported proposal teams in EPA's Advanced Measurement Initiative, which requested GEOS- related projects to integrate Earth observation data into air quality decision support systems and directed projects. NASA Applied Sciences agreed to support NASA personnel on winning proposals, since EPA funds cannot support NASA civil servants.</p> <p>1. Application of an Integrated Ozone Observing System to the Houston-Galveston-Gulf Shore Region and Eastern Great Lakes Region. Earth Science Products: OMI</p> <p>2. Modeling Fused Spatial Data for Improved Public Information on Air Quality. Earth Science Products: Aura OMI, MODIS AOD, EPA ozone and PM ground-networks, CMAQ-Eta</p> <p>3. Improving Air Accountability Assessments: 3D Air Quality and the Clean Air Interstate Rule. Earth science products: Global-regional modeling</p> <p>4. Use of Satellite Data to Evaluate PM2.5 Formation and Transport in San Joaquin Valley, California Earth science products: CALIPSO, MODIS AOD, Tapered Element Oscillating Microbalance TEOM ground measurements, LIDAR.</p>					Budget (\$K)	
					FY07	255
<i>Project Monitor/ Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	0	
AQ Team D. Neil	LaRC	FY06 - FY07	EPA	FY09	0	
				FY10	0	
				FY11	0	
<i>Principal Investigator(s)</i>				<i>Other Apps.</i>		
<i>Earth Science Products</i>	mission:					
	sensor:					
	products:					
	models:					
<i>Deliverables</i>	<u>Description</u>	<u>End Date</u>	<u>IBPD Metric #</u>			
	Project Plan					
	V&V / Operational Demo.	4/1/2007				
	Benchmark report	8/1/2007				
	Other					
<p>The four projects constitute 1.5 FTE per year for 2 years (FY06 &amp; FY07).</p> <p><i>Notes:</i></p>						



Project: ROSES 2007-2010					
<p>The purpose of this project is to assess the potential for solicited projects using NASA Earth Science Research (especially models and future sensors) to improve the performance of EPA, NOAA, USDA, and other partners’s Decision Support Systems and Emissions Inventories used in Air Quality Planning, Forecasting, and Compliance for public and environmental health and economic growth.</p> <p>Air Quality Management Program will participate in Science Mission Directorate ROSES solicitations. Projects are 3-year efforts. Solicitations and corresponding priorities may request topics related to the following issues and Earth science results: ROSES 2007 (start FY08): Compliance, Emissions Inventory, Forecasting, Planning; Glory, Accountability, GFS, Land-cover, Emissions ROSES 2008 (start FY09): Planning, Emission Inventory; OCO ROSES 2009 (start FY10): Forecasting, Compliance; NPP ROSES 2010 (start FY11): Emission Inventory, Forecasting, Planning; NPOESS</p>				Budget (\$K)	
				FY07	0
Project Monitor/ Center	Other NASA Centers	Timeframe	Partners	FY08	417
AQ Team projects selected	HQ	FY07 - FY10	Multiple	FY09	750
				FY10	1021
				FY11	1021
Principal Investigator(s)				Other Apps.	
Earth Science Products	mission: Strong emphasis on models and use of upcoming				
	sensor:				
	products:				
Deliverables	models:				
	Description	End Date	IBPD Metric #		
	ROSES 2007 Projects (2008-2010)	9/30/2010			
	ROSES 2008 Projects (2009-2011)	9/30/2011			
	ROSES 2009 Projects (2010-2012)	9/30/2012			
ROSES 2010 Projects (2011-2013)	9/30/2013				
Notes: : *** Total National Apps. funds (planned) *** ROSES 2007: 18M (over 3 years) - AQ approx. 1.25M (over 3 years) ROSES 2008: 15M (over 3 years) - AQ approx. 1.0M (over 3 years) ROSES 2009: 12M (over 3 years) - AQ approx. 0.8M (over 3 years) ROSES 2010: 18M (over 3 years) - AQ approx. 1.25M (over 3 years)					

## B. Directed Projects

The program supports directed projects to serve issues of critical strategic and tactical importance, including near-term opportunities with potential for high-return in developing relationships with partner organizations and where timeliness is critical to maintain.

Project: Planning				Directed Project	
<p>The project examines the potential for Land Information System (LIS), MODIS (MOD12 Land Cover and MOD15 Leaf Area Index) to add value to the NH3 modeling capabilities in EPA’s CMAQ decision support system and improve CMAQ accuracy, quality, or efficiency.</p> <p>Given the critical role of plants in the NH3 modeling process, the use of NASA’s observations and models in LIS could represent an important advancement over current approaches. The project specifically looks at the use of NH3 modeling representation of bi-directional fluxes as an important advancement over surface exchange models currently used by the EPA, which are typically uni-directional.</p>				<i>Budget (\$K)</i>	
				FY07	45
<i>Project Manager Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	0
Christa Peters -Lidard, Yiha Wu	GSFC	FY04 - FY07	EPA	FY09	0
				FY10	0
				FY11	0
<i>Principal Investigator(s)</i>				<i>Other Apps.</i>	
<i>Earth Science Products</i>	mission: <i>Terra, Aqua</i>				
	sensor: <i>MODIS</i>				
	products: <i>LIS, MOD12, MOD15</i>				
models:					
<i>Deliverables</i>	<u><i>Description</i></u>		<u><i>End Date</i></u>	<u><i>IBPD Metric #</i></u>	
	V&V / Prototype Demonstration		2/1/2006		
	V&V / Operational Demo.		5/1/2006		
	Benchmark report		6/30/2006		
<i>Notes:</i> Original project was to complete in September 2006; additional 45K and 9-month extension granted to project team to complete benchmark report and arrange demonstrations.					

Project: Forecasting				Directed Project	
<p>Global Forecasting System</p> <p>Project implements NASA reduced chemistry into NOAA GFS, verify improvements in GFS chemical forecasts, and validate GDAS ozone analyses using satellite observations and model products. The effort concentrates on reducing the number of chemical species currently carried in NASA research models to a minimum number that NOAA identifies as an operational constraint. The impact of improved global chemical boundary conditions on NOAA operational (CMAQ-ETA) and next generation (WRF-CHEM) National Air Quality predictions will be benchmarked using established protocols defined by NOAA and the EPA.</p> <p>The project contributes to transitioning NASA research algorithms to NOAA operations, and uses current NASA measurements (OMI, SAGE III) to provide risk mitigation for operational use of measurements from the Ozone Mapping and Profiler Suite (OMPS) on NPOESS.</p> <p>In FY07, project focuses on immediate opportunities to integrate NASA products in NOAA’s timeline and on-going activities for GFS development. The AQ program expects to solicit for project concepts in this topic in ROSES07; if no successful proposals, the program may consider continuing directed funds based on FY07 success.</p>				<i>Budget (\$K)</i>	
				FY07	334
<i>Project Manager Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	350
Pierce and DaSilva	LaRC & GSFC	FY06 - FY08	EPA, NOAA, JCSDA	FY09	265
				FY10	0
				FY11	0
<i>Principal Investigator(s)</i>				<i>Other Apps.</i>	
<i>Earth Science Products</i>	mission: <i>Terra, Aqua &amp; Aura</i> sensor: <i>MODIS, OMI</i> products: models: <i>GOCART</i>				
<i>Deliverables</i>	<u><i>Description</i></u>	<u><i>End Date</i></u>	<u><i>IBPD Metric #</i></u>		
	Project Plan	12/1/2005			
	V&V / Prototype Demonstration	11/1/2008			
	V&V / Operational Demo.	4/1/2009			
	Benchmark report	7/1/2009			
<i>Notes:</i> For FY07, the project combines two activities originally proposed to the Decisions04 and ROSES05 solicitations. FY08 & FY09 funding is placeholder in case of no successful proposals in ROSES07 and satisfactory progress, potential, and budget.					

Project: Forecasting					Directed Project	
<p>Project supports the Aura Validation effort, including field support of near-real-time global/regional model predictions and subsequent analysis. Campaign provides opportunity to work with interagency team and demonstrate capabilities of NASA Earth science products for applications by operational entities. Program supported Aura validation in FY05-07 with the R&amp;A program.</p> <p>Rapid Science Synthesis will be demonstrated at NOAA RSS Workshop in FY2007. Project will also prepare a benchmark report from Aura validation and TexAQS campaign to indicate use of NASA products in Texas SIP development (coordinated with EPA, Texas, NOAA, others)</p>					<i>Budget (\$K)</i>	
					FY07	35
<i>Project Manager Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	0	
Brad Pierce	LaRC	FY05 - FY07	NOAA, EPA, NSF, others	FY09	0	
				FY10	0	
				FY11	0	
<i>Principal Investigator(s)</i>				<i>Other Apps.</i>		
<i>Earth Science Products</i>	mission: <i>Aura, CALIPSO</i> sensor: <i>OMI, TES</i> products: models: <i>RAQMS</i>					
<i>Deliverables</i>	<u><i>Description</i></u> Benchmark report		<u><i>End Date</i></u> 5/1/2007	<u><i>IBPD Metric #</i></u>		
	<i>Notes:</i> Funding combined with funds from Research Program (Atmospheric Comp. & Tropospheric)					

Project: Compliance – NOx Accountability					Directed Project	
<p>NOx Accountability</p> <p>Project seeks to examine the potential for Earth science products (NASA-OMI, MetTop GOME2) to support EPA’s accountability analysis for the NO2 portion of the Clean Air Interstate Rule, which will help EPA and US assess policy success. A significant drop in NOx emissions from CAIR implementation is expected in 2008; the project will develop methodology relating satellite observations of NOx and reported emissions in order to facilitate direct applicability of satellite observations to EPA analysis.</p> <p>Initial activities limited to possible SN and RPC activities in FY07 to evaluate satellite/ground comparisons and potential opportunities to support EPA AQ compliance.</p> <p>Program may solicit for project concepts on this topic in ROSES07. If no successful proposals, the program may consider directed funds based on FY07 activities and partner interest (FY08-10 funding is portion of expected project cost and included as a probabilistic budget placeholder).</p>				<i>Budget (\$K)</i>		
				FY07	0	
<i>Project Manager Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	125	
AQ Team	LaRC, JPL, GSFC, MSFC	FY07 - FY07	EPA, RPOs	FY09	133	
				FY10	127	
				FY11	0	
<i>Principal Investigator(s)</i>				<i>Other Apps.</i>		
<i>Earth Science Products</i>	mission: <i>Aura, ESA Metop</i>					
	sensor: <i>OMI, GOME2</i>					
		products:				
		models:				
<i>Deliverables</i>	<u><i>Description</i></u>		<u><i>End Date</i></u>	<u><i>IBPD Metric #</i></u>		
	SN and RPC Report		2/1/2007			
	RPC Report		7/1/2007			
	Project Plan in FY08 (if necessary)					
<i>Notes:</i>						

Project: Emissions Inventory				Directed Project	
<p>Project with RPO WRAP to quantify the capability (and uncertainty) for MODIS &amp; GOES to define area burned, by comparing ground-to satellite-based data. Area burned is a fundamental factor in estimates of emissions from biomass burning. Effort enhances RPOs abilities to use satellite data to assess emissions and burned areas for years between major inventories and to help accelerate the production of annual emissions estimates. The prototype technique can extend to emissions inventory production.</p> <p>The project will deliver a FY07 benchmark report (using the EPA 2002 assessment year), along with delivery of 2005 satellite-derived fire products to the EPA and RPOs for analysis by EPA and RPOs for the 2005 assessment year .</p>				<i>Budget (\$K)</i>	
				FY07	210
<i>Project Manager Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	0
Amber Soja	LaRC	FY05 - FY07	EPA, WRAP RPO	FY09	0
				FY10	0
				FY11	0
<i>Principal Investigator(s)</i>				<i>Other Apps.</i>	
<i>Earth Science Products</i>	mission: <i>Terra, Aqua, GOES</i> sensor: <i>MODIS</i> products: models:				
<i>Deliverables</i>	<u><i>Description</i></u>		<u><i>End Date</i></u>	<u><i>IBPD Metric #</i></u>	
	V&V / Prototype Demonstration		4/1/2007		
	V&V / Operational Demo.		7/1/2007		
	Benchmark report		9/1/2007		
	Other				
<i>Notes:</i>					

Project: Emissions Inventory				Directed Project		
<p>Emissions Inv. - NBEI &amp; Fires</p> <p>This project will examine the potential for NASA Earth sciences products (sensor and model products) to integrate into the annual updates for the National Emissions Inventory (NEI), particularly for wildland and prescribed fires. If successful, the project could provide a means to improve, accelerate, and reduce the cost of updating the NEI for fire emissions.</p> <p>The program will initially focus on a report to evaluate opportunities and possible approaches with EPA and appropriate organizations. The Program may solicit for project concepts on this topic in ROSES07. If no successful proposals, the program may consider directed funds based on FY07 evaluation report and partner interest for an appropriately scoped project (coordination with BlueSkyRAINS project); FY08-10 funding is a portion of expected project cost and included as a probabilistic budget placeholder.</p>				<i>Budget (\$K)</i>		
				FY07	30	
<i>Project Manager Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	125	
AQ Team GSFC	GSFC, JPL, LaRC, MSFC	FY07 - FY07	EPA, RPOs	FY09	133	
				FY10	127	
				FY11	0	
<i>Principal Investigator(s)</i>				<i>Other Apps.</i>		
<i>Earth Science Products</i>	mission: <i>All</i>					
	sensor: <i>All</i>					
<i>Deliverables</i>	products:					
	models: <i>models</i>					
<i>Deliverables</i>	<u><i>Description</i></u>		<u><i>End Date</i></u>	<u><i>IBPD Metric #</i></u>		
	Project Plan		12/15/200			
	Report		5/1/2007			
<i>Notes:</i>						

Project: Interagency / International - Policy				Directed Project	
<p>Long Range Transboundary Air Pollution/Hemispheric Transport of Air Pollution</p> <p>The HTAP task force will issue an interim assessment on Ozone and PM in Spring 2007, and it will issue a final report in 2009. The use of Earth observations (satellite measurements and models) plays significantly in HTAP activities. HTAP will hold an integrated observations workshop in January 2007 to examine the use of Earth observations to support long-range transport issues</p> <p>Funding supports 0.25 WFE plus goods/services funds to serve as NASA coordinator on this topic. Coordinator is repsonsible for extending relevant research results and informing and involving relevant people from all NASA Earth science centers.</p>				<i>Budget (\$K)</i>	
				FY07	63
<i>Project Manager Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	60
NASA	GSFC, LaRC, JPL	FY05 - FY10	US Agencies, Internationals	FY09	60
				FY10	60
				FY11	0
<i>Principal Investigator(s)</i>				<i>Other Apps.</i>	
<i>Earth Science Products</i>	mission: sensor: products: models:				
<i>Deliverables</i>	<i>Description</i> Project Plan Evaluation Report V&V / Prototype Demonstration V&V / Operational Demo. Benchmark report Semi-Annual Reports			<i>End Date</i>	<i>IBPD Metric #</i>
<i>Notes:</i> Brief quarterly status reports					
Periodic presentations to NASA Atmospheric Composition and Air Quality Program Manager,					



Project: Future Mission Studies and Projects				Directed Project	
<p>This project is for studies and assessments on Earth science sensors (Glory, OCO, NPP, etc.) and the potential application of their data products to serve air quality decision support tools mentioned in this plan.</p> <p>FY07: Glory FY08: OCO FY09: NPP FY10: Decadal survey missions FY11: NPOESS</p> <p>If additional funds become available, the program will pursue studies on potential for CloudSat and/or CALIPSO. Each study is approximately 15K. Additional budget is for potential projects (275K per project) in case the ROSES solicitations do not select proposals using these sensors.</p>				<i>Budget (\$K)</i>	
				FY07	15
<i>Project Manager Center</i>	<i>Other NASA Centers</i>	<i>Timeframe</i>	<i>Partners</i>	FY08	15
AQ Team	GSFC, LaRC, JPL, MSFC	FY07 - FY11	US Agencies, Internationals, GEO	FY09	15
				FY10	165
				FY11	395
<i>Principal Investigator(s)</i>				<i>Other Apps.</i>	
<i>Earth Science Products</i>	mission: <i>Glory, OCO, NPP, NPOESS, others</i>				
	sensor: products: models:				
<i>Deliverables</i>	<u><i>Description</i></u>		<u><i>End Date</i></u>	<u><i>IBPD Metric #</i></u>	
	Project Plan				
	Evaluation Report				
	V&V / Prototype Demonstration				
	V&V / Operational Demo.				
	Benchmark report				
Semi-Annual Reports					
<i>Notes:</i> Brief assessment reports due approximately Feb. 1 of appropriate year					

Project: Land Cover Study and Potential Project				Directed Project																					
<p>Study/survey of the use of land cover/land use information and land characteristics in Air Quality models and decision support tools. This study should provide an overview to the major air quality models and DSSs with particular emphasis describing if and how those models/DSSs address and incorporate land characteristics, land cover/land use, land cover/use change.</p> <p>Initial activities limited to a study/survey in FY07 to inform the AQ team. Program may solicit for project concepts on this topic in ROSES07. If no successful proposals, the program may consider directed funds based on FY07 study and partner interest; FY08-10 funding is portion of expected project total and is shown as a budgetary placeholder.</p>				Budget (\$K)																					
				FY07	50																				
Project Manager Center	Other NASA Centers	Timeframe	Partners	FY08	125																				
Dale Quattrochi MSFC	MSFC-lead; others as needed	FY07 - FY10	EPA, NOAA	FY09	134																				
				FY10	126																				
				FY11	0																				
Principal Investigator(s)				Other Apps.																					
Earth Science Products	mission:																								
	sensor:																								
Deliverables	products:																								
	models:																								
	<table><tr><td>Description</td><td>End Date</td><td>IBPD Metric #</td></tr><tr><td>Project Plan</td><td></td><td></td></tr><tr><td>Evaluation Report</td><td>3/15/2007</td><td></td></tr><tr><td>V&amp;V / Prototype Demonstration</td><td></td><td></td></tr><tr><td>V&amp;V / Operational Demo.</td><td></td><td></td></tr><tr><td>Benchmark report</td><td></td><td></td></tr><tr><td>Semi-Annual Reports</td><td></td><td></td></tr></table>				Description	End Date	IBPD Metric #	Project Plan			Evaluation Report	3/15/2007		V&V / Prototype Demonstration			V&V / Operational Demo.			Benchmark report			Semi-Annual Reports		
	Description	End Date	IBPD Metric #																						
Project Plan																									
Evaluation Report	3/15/2007																								
V&V / Prototype Demonstration																									
V&V / Operational Demo.																									
Benchmark report																									
Semi-Annual Reports																									
Notes:																									

Project: Program Management Labor				Directed Project	
Labor to support Air Quality program management and project monitoring.  Deputy Program Manager: 0.5WFE Project Monitor: 0.25WFE				Budget (\$K)	
				FY07	128
Project Manager Center	Other NASA Centers	Timeframe	Partners	FY08	130
Doreen Neil	LaRC	FY07 - FY11	n/a	FY09	135
				FY10	140
				FY11	140
Principal Investigator(s)				Other Apps.	
Earth Science Products	mission: sensor: products: models:				
Deliverables	<u>Description</u>		<u>End Date</u>	<u>IBPD Metric #</u>	
	Project Plan				
	Evaluation Report				
	V&V / Prototype Demonstration				
	V&V / Operational Demo.				
	Benchmark report				
Semi-Annual Reports					
Notes:					

## V. Program Management & Crosscutting Solutions Support

### A. Program Management Activities

The Air Quality program conducts activities that contribute to the overall management, advocacy, and success of the program. Activities include studies and assessments in informal planning, interagency working group participation, publications and journal articles, support for conferences and workshops, program team meetings, and other related endeavors.

Project: Training on Application of Earth Science Observations				Project Management	
Training on Access and Use of NASA Earth Science Products for Air Quality and other application topics. Special focus on support to Developing Countries, in coordination with DAACs, EPA and USAID. Conduct training at National Conferences and special events. Supports contributions to GEO.  In FY07, the Program Director plans \$50K for development of a training module for Applied Sciences; the AQ program will support AQ portions of this module. 30K in other years is to sponsor the training at particular venues.				Budget (\$K)	
				FY07	0
Project Manager Center	Other NASA Centers	Timeframe	Partners	FY08	30
AQ Monitor	GSFC, LaRC, JPL, MSFC	FY07 - FY11	EPA, USAID, GEO, UNOOSA, others	FY09	30
				FY10	0
				FY11	30
Principal Investigator(s)				Other Apps.	
Earth Science Products	mission: sensor: products: models:				
Notes:  FY07 is for development of training materials and UNOOSA/GEO training. Future years is for appropriate US and/or GEO training activities.  Training may well include information on GEONETCast and data availability and analysis. Role for NASA DAACs to support training efforts.					

Project: AQ Communication, Outreach, and Conferences				Project Management	
AWMA Annual Meetings: 10K per year  AMS Forecasters Meeting - alternate years: 2007, 2009, 2011  Communications - AQ Event Stories/Articles (with EPA): 30K in 2007-2009  Other communication activities: 25K in FY11  EPA National Air Quality Forecasters annual meeting: If funds become available, program may sponsor or do a booth at this event.				Budget (\$K)	
				FY07	40
Project Manager Center	Other NASA Centers	Timeframe	Partners	FY08	40
Lawrence Friedl HQ	GSFC, LaRC, JPL	FY07 - FY11	EPA, NOAA, others	FY09	40
				FY10	40
				FY11	35
Principal Investigator(s)				Other Apps.	
Earth Science Products	mission: sensor: products: models:				
	Notes:				

Project: Committee Support; AQ Program Team				Project Management	
Support for national and international committees, such as IGOS/IGACO and NARSTO, and special reports, such as CENR-AQRS transport.  Funds also support meetings of the Air Quality Program Team.				Budget (\$K)	
				FY07	15
Project Manager Center	Other NASA Centers	Timeframe	Partners	FY08	15
Lawrence Friedl HQ	GSFC, LaRC, JPL, MSFC	FY07 - FY11		FY09	15
				FY10	15
				FY11	15
Principal Investigator(s)				Other Apps.	
Earth Science Products	mission: sensor: products: models:				
	Notes:				

## **B. Crosscutting Solutions Support**

The Air Quality program works with the Crosscutting Solutions Element within the Applied Sciences Program to develop project concepts and enable management objectives. The program expects to pursue the following activities with the four Crosscutting Solutions sub-elements:

### *Integrated Benchmark Solutions*

The Air Quality program plans to utilize the Rapid Prototyping Capability that the Applied Sciences Program supports at various locations and NASA Centers to identify candidate configurations for possible integrated system solutions. The program plans to select a subset of the candidate configurations for inclusion in the following year's ROSES solicitation. The Air Quality program focuses the RPC activities on the following air quality issues and DSTs for FY07-11:

FY07:

NO<sub>x</sub> Accountaility (Proof of concept with satellite and ground NO<sub>x</sub> data). SO<sub>x</sub>, NO<sub>x</sub> and CMAQ, AirNOW

FY08: Clouds & Physical Meterology (separate from McNider project)

FY09: CO, CO<sub>2</sub>

FY10: Mercury

FY11: POPs

### *Solutions Networks*

The Air Quality program plans to work with the Solutions Network activity to identify configurations of specific research results that may be candidates for Integrated System Solutions and/or priorities for Rapid Prototyping activities. The program expects to meet with Solutions Networks representatives on a quarterly basis to review the results that the representatives have identified.

In FY07, the program encourages SN candidate solutions in the following areas: NO<sub>x</sub> & AIRNow forecasts; Use of Aura and Glory; SO<sub>x</sub> and NO<sub>x</sub> with CMAQ; Emissions inventories.

### *DEVELOP*

The program expects to pursue the following air quality -related projects with the DEVELOP program in FY07, FY08, and FY10.

FY07: Aerosol/PM transport in National Parks

FY08: African PM transport

FY10: Ozone and NO<sub>x</sub> in Forecasting

*GIO*

The Air Quality program plans to support interagency efforts (e.g., GEO NTO AQ portal of portals), and results from several NASA-supported projects (especially REASoN-Falke and ESIP Federation) may support the efforts. These efforts may require interoperability tools developed and prototyped under ES Gateway.

FY07: Air Quality Portal of Portals with GEO NTO; GEONetCast Products; EPA National Emissions Inventory

FY08: Air Quality Portal of Portals with GEO NTO; GEONetCast; DataFed continuation; ESIP Air Quality Cluster Data Access/Capacity Building projects

FY09: DataFed continuation; ESIP Air Quality Cluster Data Access/Capacity Building projects

FY10: ESIP Air Quality Cluster Data Access/Capacity Building projects

FY11: ESIP Air Quality Cluster Data Access/Capacity Building projects



**VI. Budget: FY07-11**

The following table lists the Air Quality Program budget for FY2007 - FY2011

<b><u>Project</u></b>	<b><u>FY07 (\$K)</u></b>	<b><u>FY08 (\$K)</u></b>	<b><u>FY09 (\$K)</u></b>	<b><u>FY10 (\$K)</u></b>	<b><u>FY11 (\$K)</u></b>
ROSES 05-Forecasting (McHenry)	331	311			
ROSES05	335	323			
EOS Follow-on: EOS Products for Air Quality Management	335				
Decisions 04	421				
Three-Dimension Air Quality System (3D-AQS)					
Decisions04	312				
REASoN	334				
EPA STAR - Emissions Inventory (Diner)	50				
EPA AMI	225				
ROSES 2007-2010	0	417	750	1021	1021
Planning	45	0	0	0	0
Forecasting	334	350	265	0	0
Forecasting	35	0	0	0	0
Compliance – NOx Accountability	0	125	133	127	0
Emissions Inventory	210	0	0	0	0
Emissions Inventory	30	125	133	127	0
Interagency / International - Policy	63	60	60	60	0
Future Mission Studies and Projects	15	15	15	165	395
Land Cover Study and Potential Project	50	125	134	126	0
Program Management Labor	128	130	135	140	140
Training on Application of Earth Science Observations	0	30	30	0	30
AQ Communication, Outreach, and Conferences	40	40	40	40	35
Committee Support; AQ Program Team	15	15	15	15	15
<b>Total = \$</b>	<b>3308</b>	<b>2066</b>	<b>1710</b>	<b>1821</b>	<b>1636</b>

## VII. Schedule and Milestones for Air Quality

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
ROSES 05	FY07	Project Plan	1/1/2008
		Evaluation Report	1/1/2008
		V&V / Prototype Demonstration	10/1/2009
		V&V / Operational Demo.	1/1/2009
		Benchmark report	8/1/2009

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
ROSES05	FY07	Project Plan	1/1/2008
		Evaluation Report	1/1/2008
		V&V / Prototype Demonstration	10/1/2009
		V&V / Operational Demo.	1/1/2009
		Benchmark report	8/1/2009

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
EOS Follow-on: EOS Products for Air Quality Management	FY06	Project Plan	
		Evaluation Report	
		V&V / Prototype Demonstration	5/1/2008
		V&V / Operational Demo.	6/1/2008
		Benchmark report	6/1/2009

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Decisions 04 Three-Dimension Air Quality System (3D-AQS)	FY06	Project Plan	9/1/2006
		Evaluation Report	
		V&V / Prototype Demonstration	8/1/2008
		V&V / Operational Demo.	2/1/2009
		Benchmark report	6/1/2009

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Decisions04	FY06	Project Plan	9/1/2006
		V&V / Prototype Demonstration	8/1/2008
		V&V / Operational Demo.	2/1/2009
		Benchmark report	6/1/2009

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
REASoN	FY04	Project plan	
		Semi-annual reports	
		Results conference	

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
EPA STAR - Emissions Inventory	FY07	Benchmark report	6/1/2008

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
EPA AMI	FY06	Project Plan	
		V&V / Operational Demo.	4/1/2007
		Benchmark report	8/1/2007
		Other	

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
ROSES 2007-2010	FY07	ROSES 2007 Projects (2008	9/30/2010
		ROSES 2008 Projects (2009	9/30/2011
		ROSES 2009 Projects (2010	9/30/2012
		ROSES 2010 Projects (2011	9/30/2013

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Planning	FY04	V&V / Prototype Demonstration	2/1/2006
		V&V / Operational Demo.	5/1/2006
		Benchmark report	6/30/2006

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Forecasting	FY06	Project Plan	12/1/2005
		V&V / Prototype Demonstration	11/1/2008
		V&V / Operational Demo.	4/1/2009
		Benchmark report	7/1/2009

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Forecasting	FY05	Benchmark report	5/1/2007

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Compliance – NOx Accountability	FY07	SN and RPC Report	2/1/2007
		RPC Report	7/1/2007
		Project Plan in FY08 (if	

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Emissions Inventory	FY05	V&V / Prototype Demonstration	4/1/2007
		V&V / Operational Demo.	7/1/2007
		Benchmark report	9/1/2007
		Other	

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Emissions Inventory	FY07	Project Plan	12/15/2006
		Report	5/1/2007

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Interagency / International - Policy	FY05	Project Plan	
		Evaluation Report	
		V&V / Prototype Demonstration	
		V&V / Operational Demo.	
		Benchmark report	
		Semi-Annual Reports	

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Future Mission Studies and Projects	FY07	Project Plan	
		Evaluation Report	
		V&V / Prototype Demonstration	
		V&V / Operational Demo.	
		Benchmark report	
		Semi-Annual Reports	

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Land Cover Study and Potential Project	FY07	Project Plan	3/15/2007
		Evaluation Report	
		V&V / Prototype Demonstration	
		V&V / Operational Demo.	
		Benchmark report	
		Semi-Annual Reports	

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Program Management Labor	FY07	Project Plan	
		Evaluation Report	
		V&V / Prototype Demonstration	
		V&V / Operational Demo.	
		Benchmark report	
		Semi-Annual Reports	

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Training on Application of Earth Science Observations	FY07		

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
AQ Communication, Outreach, and Conferences	FY07		

<i>Project</i>	<i>Start Date</i>	<i>Deliverable</i>	<i>End Date</i>
Committee Support; AQ Program Team	FY07		

## **VIII. Program Measures**

The Air Quality Management team uses measures to track progress within and across projects to ensure the program meets its goal and objectives. The measures are in two categories: Program Management measures are internally-focused to assess how the program conducts its activities, including the inputs, outputs, production, quality, and efficiency of projects. Performance measures are externally-focused to assess if the program's projects and activities are serving their intended purpose. The management team analyzes these measures retrospectively in order to make adjustments prospectively to the program approach and objectives.

### **Program Management Measures (Internally-focused):**

- Range of AQ DSSs evaluated in each future mission study
- Number and range of AQ models/DSSs in land cover assessment
- Number of reports delivered by deadline
- Range and type of analytic methods used in benchmark reports
- Use of quantitative analysis and partners' DSS metrics in benchmark reports
- Articulation of partners' DSS metrics in project plans (or appropriate document)
- Articulation of baseline quantitative performance of partners' DSS metrics

### **Performance Measures (Externally-focused):**

- Benchmark reports – quantitative/qualitative change in partner's metrics
- Change in performance measures identified by the project team
- Transition, adoption, and/or statements from partner(s) on value of Earth science to their decision systems/processes
- Quantitative assessment of socio-economic value of Earth science products in DSSs

In addition to the stated measures, the Air Quality Management program periodically requests an assessment of its plans, goals, priorities, and activities through external review. The National Academy of Sciences National Research Council is reviewing the Applied Sciences Program (including the Air Quality Management program) in FY06-07. The program expects another review of the program in the FY10 timeframe.

## **Appendix A: Program Element Partners**

### **A. Program Management**

Program Manager:

Lawrence Friedl  
NASA-Headquarters  
202-358-1599  
LFriedl@nasa.gov

Deputy Program Manager:

Doreen Neil  
Langley Research Center  
228-688-8171  
Doreen.O.Neil@nasa.gov

The Applied Sciences Program website contains additional information about national and regional organizations and their points of contact regarding this program element:

Applied Sciences Program: <http://science.hq.nasa.gov/earth-sun/applications>

Air Quality Management Element: <http://science.hq.nasa.gov/earth-sun/applications/theme2.htm>

### **B. Air Quality Network & Partners**

The program element maintains a network of organizations and points-of-contact associated with Air Quality activities.

Earth Science Division and NASA Centers:

Atmospheric Composition Theme ..... Phil DeCola, NASA HQ  
Climate Change and Variability Theme..... Don Anderson, NASA HQ  
Tropospheric Chemistry and Aerosols..... Hal Maring, NASA HQ

Federal Partners:

US EPA

Terry Keating (EPA-OAR), Jim Szykman (EPA at NASA-LaRC), Gary Foley (ORD), Ed Washburn (ORD)

NOAA

Jim Maegher, Shoba Kondragunda, Steve Fine

US Department of Agriculture (USDA)

Ray Knighton, Al Ribeau

Regional Planning Organizations:

CENRAP: Central Regional Air Planning Association

MANE-VU: Mid-Atlantic/Northeast Visibility Union

Midwest RPO: Midwest Regional Planning Organization

VISTA: Visibility Improvement State and Tribal Association of the Southeast

WRAP: Western Regional Air Partnership

International, National and Regional Organizations:

NARSTO (formerly North American Research Strategy for Tropospheric Ozone)

IGOS: Integrated Global Observing Strategy (IGACO – Atmospheric Composition Theme)

ECOS: Environmental Council of the States

Washington University at St. Louis – NASA Cooperative Agreement

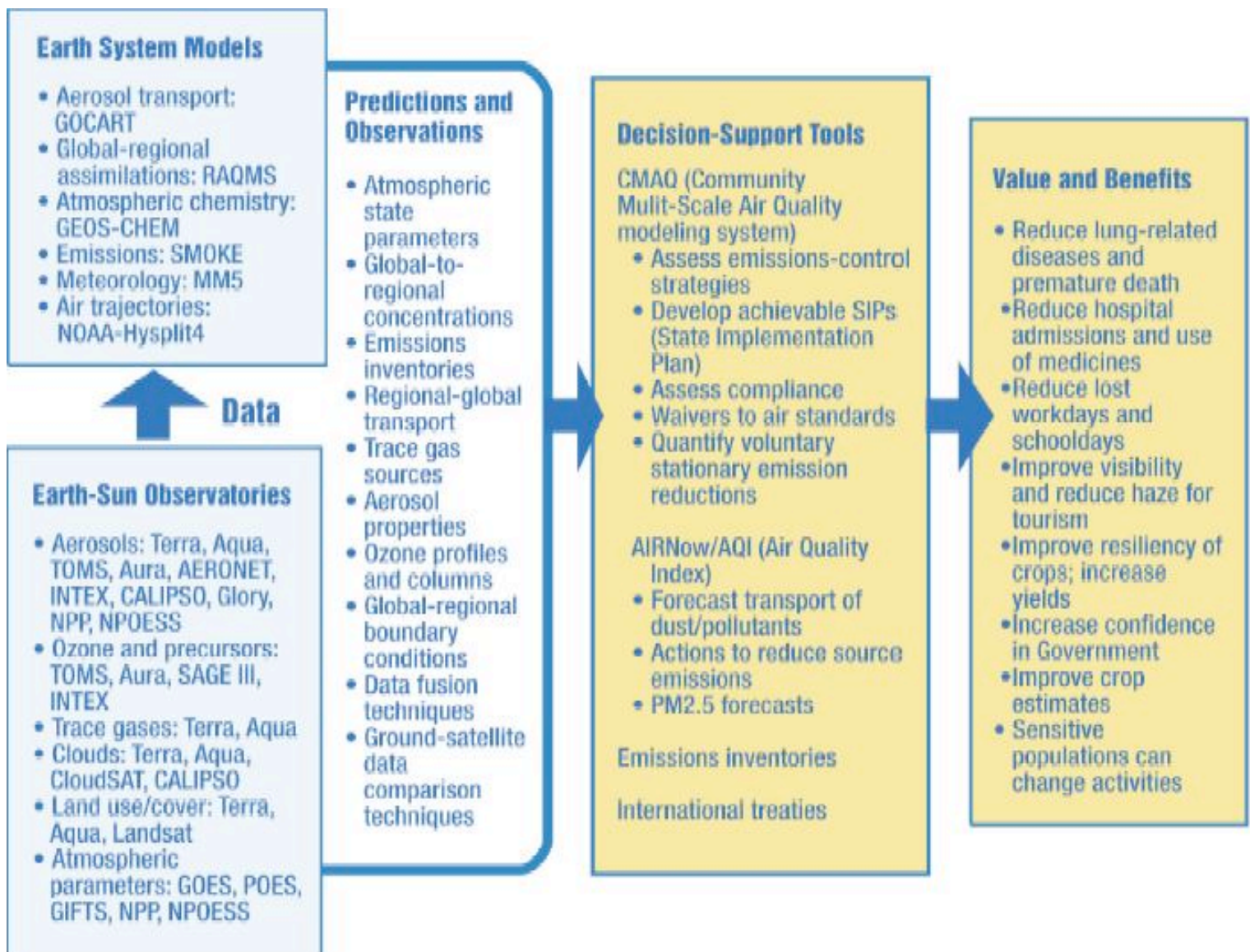
A&WMA: Air & Waste Management Association



## Appendix B: Road Maps

### A. Integrated System Solutions Diagram

Appendix A illustrates a candidate configuration for the extension of NASA science measurements, model products, and data fusion techniques to support Air Quality partners, their decision support tools, and benefits of Earth science to society. Results from NASA Earth system science are typically observations, data sets, climate data records, algorithms, and models utilizing the observations. Observations for Air Quality Management include measures of aerosols, ozone, trace gases, cloud properties, meteorology, and land-cover/use. Models use these and other measurements to generate predictions of atmospheric and air quality conditions (e.g., aerosol transport, emissions sources, ozone levels) and to assimilate data from global-to-regional scales. The Air Quality program works with partners on methods for their decision support tools - AIRNow, CMAQ, WRF - to ingest NASA science observations and predictions and, in turn, improve the capabilities of their tools to serve their decision processes and, ultimately, the public.



## B. Roadmap

The figure illustrates the evolving, progressive nature of links between the increasing capabilities of NASA-supported research, measurement systems, and technology and their extension to partners' management and policy responsibilities. The yellow bars on the left state the expected research and developments from Earth system science and technology; the blue bars to the right reflect the contributions of the research in terms of improved management capabilities. Each level shows a steady improvement in the measurements and research along with enhanced management capabilities and public value. This Air Quality application roadmap builds on the roadmaps of the six Applied Sciences Science Focus Areas, particularly the Atmospheric Composition Theme, Weather Theme, and Climate Variability and Change Theme.



## Appendix C: Acronyms

A&WMA	Air & Waste Management Association
AERONET	Aerosol Robotic Network
AIRS	Airborne Infrared Sounder
AMSU	Advanced Microwave Sounding Unit
AOD	Aerosol Optical Depth
APS	Aerosol Polarimetric Sensor
AQI	Air Quality Index
Aqua	Spacecraft with instruments to collect information on Earth's water cycle
Aquarius	Spacecraft with instruments to map global salt concentrations on ocean surface
ARC	Ames Research Center
ATBD	Algorithm Theoretical Basis Document
Aura	Spacecraft with instruments to study Earth's ozone, air quality, climate
BlueSkyRAINS	BlueSky Rapid Access Information System
CALIPSO	Cloud-Aerosol LIDAR and Infrared Pathfinder Satellite Observations
CCSP	Climate Change Science Program
CCTP	Climate Change Technology Program
CENR	Committee on Environment and Natural Resources
CENRAP	Central Regional Air Planning Association
CERES	Clouds and the Earth's Radiant Energy System
CIMSS	Cooperative Institute for Meteorological Satellite Studies
CMAQ	Community Multi-scale Air Quality model
COT	Cloud Optical Thickness
DAAC	Distributed Active Archive Center (Data Active Archive Center)
DEVELOP	No longer an acronym
DSS	Decision Support Systems
DST	Decision Support Tool
ECOS	Environmental Council of the States
EDR	Environmental Data Records
EOS	Earth Observing Systems
EOSDIS	Earth Observing System Data Information System
EP-TOMS	Earth Probe – Total Ozone Mapping Spectrometer
EPA	Environmental Protection Agency
EPHTN	Environmental Public Health Tracking Network
ESIP	Earth Science Information Partnership
FAA	Federal Aviation Administration
FEA	Federal Enterprise Architecture
FGDC	Federal Geographic Data Committee
FY	Fiscal Year
GCM	Global Climate Model
GEO	Group on Earth Observations
GEOS-CHEM	Goddard Earth Observing System-CHEMistry
GEOSS	Global Earth Observation System of Systems
GES DAAC	Goddard Earth Science Distributed Active Archive Center
GISS	Goddard Institute for Space Studies



GMAO	Global Modeling and Assimilation Office
GMES	Global Monitoring for Environment and Security
GOCART	Global Ozone Chemistry Aerosol Radiation Transport
GOES	Geostationary Operational Environmental Satellite
GSFC	Goddard Space Flight Center
HCHO	Formaldehyde
HRDLS	High-Resolution Dynamics Limb Sounder
HSB	Humidity Sounder for Brazil
HYDROS	Hydrosphere State Mission
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
IBPD	Integrated Budget and Performance Document
IGACO	Integrated Global Atmospheric Chemistry Observations
IGOS	Integrated Global Observations Strategy
JACIE	Joint Agency Commercial Imagery Evaluation
JCSDA	Joint Center for Satellite Data Assimilation
JPL	Jet Propulsion Laboratory
LaRC	Langley Research Center
MANE-VU	Mid-Atlantic Northeast Visibility Union
MISR	Multiple Input Shift Register
MM5	Mesoscale Model
MODIS	Moderate Resolution Imaging Spectroradiometer
MOPITT	Measurements Of Pollution In The Troposphere
MSFC	Marshall Space Flight Center
NARSTO	Formerly North American Research Strategy for Tropospheric Ozone
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NESDIS	National Environmental Satellite Data Information Service
NH3	Ammonia
NO2	Nitrogen Dioxide
NOx	Refers to different Nitrogen Oxide atmospheric compounds
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
NSF	National Science Foundation
NWS	National Weather Service
OAQPS	Office of Air Quality Planning and Standards
OAR	Office of Oceanic and Atmospheric Research
OCO	Orbiting Carbon Observatory
OMB	Office of Management and Budget
OMI	Ozone Monitoring Instrument
ORD	Office of Research and Development (US EPA)
OSSE	Observing System Simulation Experiment
PART	Program Assessment Rating Tool
PM	Particulate Matter; Project Manager

RAQMS	Regional Air Quality Modeling system
REASoN	Research, Education, and Applications Solutions Network
RPO	Regional Planning Organization
SO <sub>2</sub>	Sulfur Dioxide
SSC	Stennis Space Center
TBD	To Be Determined
Terra	Spacecraft with instruments measuring Earth's climate
TES	Thermal Emission Spectrometer
TOMS	Total Ozone Mapping Spectrometer
U Md – CP	University of Maryland at College Park
UMBC	University of Maryland Baltimore County
USDA	US Department of Agriculture
USFS	US Forest Service
V&V	Verification & Validation
VIIRS	Visible/Infrared Imager/Radiometer Suite
VISTA	Visibility Improvement State and Tribal Association of Southeast
VOC	Volatile Organic Compound
WRAP	Western Regional Air Partnership
WRF	Weather Research and Forecast
WRF-CHEM	Weather Research Forecast - Chemistry

**NASA Science Mission Directorate**  
**Earth Science Division - Applied Science Program**  
***Air Quality Program Element***

*This document contains the Air Quality Program Element Plan for FY 2007-2011 DRAFT*

This plan derives from direction established in the NASA Strategic Plan, Earth Science Enterprise and Space Science Enterprise Strategies, Earth Science Applications Plan, and OMB/OSTP guidance on research and development. The plan aligns with and serves the commitments established in the NASA Integrated Budget and Performance Document.

The Program Manager and the Applied Sciences Program Leadership have reviewed the plan and agree that the plan appropriately reflects the goals, objectives, and activities for the Program Element to serve the Applied Sciences Program, Earth Science Division, NASA, the Administration, and Society.

---

Lawrence Friedl  
Program Manager, Air Quality  
Applied Sciences Program  
NASA Earth Science Division

---

Date

---

Lawrence Friedl  
Lead, National Applications  
Applied Sciences Program  
NASA Earth Science Division

---

Date

---

Teresa Fryberger  
Director, Applied Sciences Program  
NASA Earth Science Division

---

Date